MECHANICAL HARVESTING[1]

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Attempts to solve the cotton-picking problem have been spread over a long period of time. Innumerable patents have been granted on machines that would supposedly pick cotton. However, very few of these have proved even partially successful. We should rightfully consider the cotton harvester a mechanical evolution resulting from many years of tedious trials, disappointments, set-backs, and failures by ever-persistent designers.

Although mechanical-harvesting devices fall into five general classes-- the picker type, the thresher type, the electrical type, the pneumatic type, and the stripper type-- present-day successful harvesters may be classed as (1) strippers, or rough harvesters, and (2) pickers. Strippers are more readily adaptable to cotton grown in the High Plains of Texas and similar areas. Due to types of cotton grown and the more luxuriant growth of the plant, we in this section of the Cotton Belt are, however, concerned chiefly with the cotton picker.

In areas such as the Mississippi Delta where there is an abundant stalk growth, not only would there be a severe cleaning problem connected with the use of strippers, but the lack of uniformity in opening would also fail to lend this type of cotton to rough harvesting methods. So far we can assume the picker is a more suitable machine for most of the Cotton Belt.

A number of experimental machines are in various stages of development today. During the past season agricultural engineers at the Delta Branch Experiment Station had the opportunity of observing a demonstration of only one of these, a Rust type picker manufactured by Allis-Chalmers Company for experimental purposes. Despite certain operational difficulties yet to be overcome, the possibilities for a workable picker were very evident. Several other machines still in the process of development may also eventually prove successful in meeting the mechanical harvesting needs of various producers. One of the greater problems yet facing the picker manufacturers would be a machine for the hill farmer, who is confronted with contour rows, short turns, rocks or stones, and narrow rows, which are necessary for maximum yields. One small manufacturer contacted recently is attempting to solve the needs of this particular class with a suction type picker.

1/ Cooperative investigations between the Bureau of Plant Industry, Soils, and Agricultural Engineering, U. S. Department of Agriculture, and the Mississippi Agricultural Experiment Station, Delta Branch Station, Stoneville, Mississippi.

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Since the advent of a successful picker during the recent war, keen interest has been shown among cotton growers for mechanical harvesters. Production of all farm machinery has been limited, however, during this period. The only picker in production available to the Delta Experiment Station the past season was the International Harvester spindle type machine. It is the only type of picker produced by this company now and is a high-drum machine, which is designed for cotton with a stalk over 30 inches in height. Classified as a one-man, one-row machine, it is mounted on a modified Farmall tractor which serves as a vehicle and furnishes the power for operation of the picking mechanism. A large, open-mesh basket is carried atop the machine for storage of the pickings prior to dumping into a truck or trailer. This basket has a capacity of approximately one-half bale of cotton.

At the Delta Experiment Station the past season we operated two of these high-drum machines. Both machines were of the latest design, one being owned outright by the Delta Station and the other being placed there for experimental operation. The barbed picking spindles on the Station picker were .006 inch ± .002 inch in height, while the experimental machine was equipped with a more aggressive type spindle carrying barbs .024 inch ± .002 inch in height.

Comparisons were made between the mechanical operation of the two machines and, in addition, a series of tests involving varieties of cotton, defoliation, effect of planting and cultivating practices, picking methods, wetting agents, and textile-conditioning oils was carried out. With analysis of only a small part of the past season's data completed, results of the cotton-harvesting tests are limited to preliminary inspections and field observations.

The average grade of all the machine-picked cotton at the Station compares favorably with that picked by hand. Some of the early samples from well defoliated fields classed as high as Middling, with one especially bred variety getting a grade of Good Middling. The grades ranged from Low Middling to Middling. Aside from defoliation, certain other factors accounting for the relatively satisfactory grades were (1) the absence of vines and weeds due to late cultivation and flaming, (2) the flat, shallow type cultivation methods, and (3) the scarcity of open bolls near the ground. The latter condition could logically be the result of burning off the lower branches during flaming operations. During the picking operation, a considerable amount of foreign matter is often gathered into the machine when the picker head must travel near the ground. Consequently, picker manufacturing engineers were especially interested when noting the "pruned" condition at the base of the cotton stalk. Tests in 1945 showed as much as 0.04 of a grade improvement in flamed cotton.

Variety tests in recent years have indicated a tendency in certain so-called smooth-leaved cottons to "clean up" during ginning much more readily than hairy-leaved varieties. Tests in 1946 appear to confirm strongly that trend; in fact our data show that there is at least one variety which gives better results when machine picked than other varieties when hand picked. Progress in this direction by the breeders would aid mechanical harvesting very substantially. Preliminary analysis of tests on eight varieties of cotton involving different staples, plant characteristics, and pilosity of leaf, and studies of the effects of hand picking versus machine picking as related to defoliation versus non-defoliation reveal several highly significant relationships.

Harvesting experiences in relation to different planting methods have been somewhat limited at the Station. In test plots, checked and cross-plowed cotton seemed less suited to mechanical pickers than drilled or hill-dropped cotton. In other words, the picker apparently is more efficient when the plants are distributed evenly along the row than when the same amount of cotton is bunched at approximately 40-inch intervals with a wide hill spread. Methods of cultivation are believed definitely to affect mechanical harvesting. As pointed out previously, thorough and late flame cultivation is an aid to clean picking. Observations during the past season indicated also that the flat, shallow type of cultivation practiced at the Delta Station provided a firmer middle and a more uniform field condition. This fact affirms the belief that preparations for mechanical harvesting should begin early, even before planting.

Due to comparatively ideal picking conditions throughout most of the season, tests comparing various picking methods revealed less information than would normally be expected under varying weather conditions. Very few strippers were used in 1946; therefore tests with this type machine at the Delta Station were postponed after attempts to secure one for experimental purposes failed.

One of the most timely studies attempted on both the regular and the aggressive type spindles involved water, wetting-agent solutions, and textile-conditioning oils. In this connection it must first be made clear that a liquid is necessary for the proper functioning of the picking and doffing mechanisms. Two wetting agents, Bucolene and Nopco, were each applied in widely varying solutions with water and compared with the standard or recommended agent which is water alone. Apparatus for applying oils was also installed on the machines, and two different oils, Bucol-A and Texspray, were used to moisten the spindles in additional tests and checked against water.

All of the wetting agents and oils used worked fairly satisfactorily, but a more efficient agent is indicated for increased spindle efficiency. The problem of keeping the picking spindles free of honeydew and plant juices promises to be one for further study. Both Bucolene and Nopco reduced the water requirements of the spindles when used in proper proportions with water. It seems probable that present water requirements may be reduced approximately one-half when a proper solution of one of these agents is used. Water added during picking will increase drying requirements at the gin. This fact also creates a storage problem in event immediate ginning is impossible. This problem especially concerns the producers of planting seed when they plan to use mechanical pickers for harvesting and the general grower when pickers become more common. Successful use of oils such as Texspray and Bucol-A would probably eliminate the moisture problem. Station experiments have indicated slightly different effects in spindle operation between the two oils, but additional tests will be run before definite recommendations can be made. Atmospheric conditions, such as clouds, heavy dews, and fogs, may be a limiting factor in the use of oils, since the oils do not tend to mix with the moisture in the seed cotton and seem to work best when the cotton is relatively dry.

Little difference has been observed thus far in studying data comparing the high barbed or aggressive spindles with the regular type spindles as related to picking efficiency and grade. In gleaning the rows behind the two pickers, running side by side, there was not a significant difference in the amount of cotton left by either of the machines.

Results of picking efficiency studies at the Station have revealed significant differences among certain varieties as well as among planting methods. As mentioned earlier, the somewhat bushy growth of checked or cross-plowed cotton tends to impede or slug the picking mechanism, thereby decreasing the machine's picking capacity and efficiency. Field wastes were determined by gleaning all open bolls left on the ground and stalk by the machines. Efficiencies for one test averaged approximately 94 percent; others ranged from 86 percent to 97 percent, depending upon variety and planting method.

It may be interesting to note a few experiences of Delta farmers with mechanical pickers during 1946.3/ Few of the farmers owning mechanical pickers in the Mississippi Delta made maximum use of them during the past season.

3/ Unpublished data from a study of the economic aspects of mechanization which is being made by the Mississippi Experiment Stations and the Bureau of Agricultural Economics.

An unusually short crop in most sections, together with a good supply of hand pickers at a fair wage, caused most owners to use hand labor in attempts to obtain the returns from higher grades and to avoid any seed-cotton losses from machine picking. Lack of proper defoliation and the uneven opening of the crop, coupled with an unusually long picking season, encouraged the use of hand pickers to some extent. In two or three instances those farmers with exceptionally short crops sold their pickers to others willing to pay an excessive price for the machines. A limited quantity of machines was produced the past year, which means, of course, that a very limited number of the most improved types are in operation. The approximate number of machines in the Yazoo-Mississippi Delta today is around 75 to 100. There is one highly mechanized farm near Clarksdale, Mississippi, on which 15 pickers are used to harvest the entire crop of about 3000 acres of cotton.

A number of owners reported use of their machines in combination with hand picking; that is, hand pickers were used for early harvesting while plants were still fully leaved, and the mechanical pickers were used for the late picking or the scrapping operation.

Plans for next season's picker studies will involve not only a continuation of the tests now under way, but will also include the study of new problems that have been experienced during more recent operations. Additional information is needed on defoliation. The date, rate, and method of application of agents apparently affect the results obtained. Uniformity is also important in this operation. Further study should be made on the possibilities of increased use of wetting agents and textile-conditioning oils for proper spindle moistening. Loss of grade and picking efficiency will be more and more important to operators of mechanical harvesters. Keeping these losses to a minimum should continue to draw the attention of those attempting improvements in pickers.

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